WP 42

Bird Strikes to U.S. Air Force Aircraft 1987 - 1991

Major Ronald L. Merritt
Captain Robert L. Dogan
Bird Aircraft Strike Hazard (BASH) Team
HQ AFCESA/DMP, Tyndall AFB, Florida

Each year the U.S. Air Force (USAF) suffers significant aircraft damage from bird strikes. Between 1987 and 1991 USAF activities worldwide reported over 14,000 bird strikes to the USAF Bird Aircraft Strike Hazard (BASH) Team. During this period, five aircraft were destroyed, one suffered damage in excess of one million U.S. dollars, and five aircrew members were fatally injured, all due to aircraft collisions with birds. The average annual cost to the USAF is in excess of 59 million dollars (U.S.) not to mention the cost in human lives and agonizing suffering. The following are summaries of all Class A mishaps (mishaps that resulted in the destruction of the aircraft, involved loss of life, or sustained damage in excess of $1,000,000) due to collisions with birds for the period of 1987 through 1991.

- In May 1987, an F-4E operating over the Bardenas-Reales bombing range struck a 20 pound Griffon Vulture (*Gyps fulvus*) during high speed low-level flight. The bird penetrated the windscreen of the aircraft, killing the pilot. The weapons system operator was subsequently killed when the aircraft impacted the ground seconds later. The aircraft was destroyed with cost estimates exceeding $17,000,000.

- In September 1987, a B-1B operating on a high speed low-level training route in LaJunta, Colorado struck a 15 pound American White Pelican (*Pelecanus erythrorhynchos*) while traveling at 500 knots and 600 feet above the ground. Three crew members ejected safely after control of the aircraft was lost. The remaining three crew members were killed when the aircraft crashed into the ground. The aircraft was destroyed with cost estimates exceeding $215,000,000.

- Later in December 1987, an E-4B (modified Boeing 747) departed Offutt AFB, Nebraska on a routine mission. During climb-out the aircraft struck numerous Snow Geese (*Chen caerulescens*) weighing an average of 5.5 pounds each. The aircraft was immediately and successfully recovered to the base. No injuries or fatalities were attributed to this mishap. Damage to the aircraft exceeded 1.5 million dollars.

- During 1988 no Class A mishaps due to bird strikes were reported. However during early January 1989 an F-16A operating over the Avon Park Bombing Range in Florida was lost after it struck a 4.5 pound Turkey Vulture (*Carthartes aura*). The aircraft was egressing the target when the collision occurred. The Turkey Vulture struck the aircraft and penetrated the canopy. The pilot was temporarily and partially paralyzed by the bird and aircraft debris. The pilot successfully ejected. His injuries

were minor and he was returned to flight status. The aircraft was totally destroyed at a cost estimate of $10,000,000.

o Only days after the preceding mishap, an F-16C at Shaw AFB, South Carolina was on its takeoff roll when it struck several starlings. The pilot initiated an unsuccessful high-speed abort resulting in the loss of the aircraft. The pilot escaped uninjured, however, the aircraft was destroyed. Cost estimates for this mishap exceed $10,000,000.

o The next Class A mishap resulting from a bird strike occurred more than a year later when an F-16A from the Ft Smith Air National Guard in Arkansas ingested a 4.5 pound Turkey Vulture (*Carthartes aura*) while on a low-level training mission. The pilot ejected successfully, but the aircraft was destroyed at an estimated cost of $9,000,000.

These are the most graphic examples of the devastating effects birds had on our aircraft during the past five years. Although many of the most damaging bird strikes occurred during high speed low-level flight, aircraft can be severely damaged and even destroyed during any phase of flight. Even with the perception of a reduced military threat in Europe, aircrews must continue to train to meet contingencies worldwide. High speed low-level flight continues to offer pilots the elements of evasion and of surprise, but it also places them in the same airspace where most bird activity occurs. The USAF BASH Team is aggressively increasing efforts to identify bird hazards in low-level airspace. An enhanced Bird Avoidance Model (BAM) for North America is under development. Reducing bird hazards on and around USAF installations requires continued education and training for base personnel. Since 1987, a decrease in the number of Class A mishaps from bird strikes has been observed. The BASH Team continues to conduct instruction at the Flight Safety Officers' School, University of Southern California, Norton AFB, California and the Flight Safety NCO's Course, Lowry AFB, Colorado. These efforts have advanced the awareness of the BASH potential Air Force wide and have improved the BASH programs at USAF installations worldwide.

The following is a summary of bird strike data reported throughout the Air Force for the period beginning January 1987 through June 1991. Due to a change in reporting periods, the data for the last six months of 1991 will not be available until April 1992. No statistical analysis is offered here, but this information is useful to identify trends and used to focus future BASH Team efforts.

Aircraft Involved in Bird Strikes

For the period of 1987 through 1991 virtually every aircraft in the USAF inventory reported bird strikes, some in greater numbers and frequency than others. Figure 1 shows the aircraft type that reported the most strikes. Cargo and fighter/attack aircraft continue to report bird strikes in the greatest number and frequency. With increased emphasis on low-level flight for almost every weapons system, we expect the numbers to continue to climb barring no intervention.

Impact Location

The frontal surfac
directly related to
the percentage of

Again, transparen
by the BASH Tea
heavier birds at hi
aircrew while ope
on the F-15E, a c
bird strike that sh

Bird Strikes by Al

The distribution o
At almost any alti
37,000 feet. Most
strikes are reporte
bird strikes by alti
bird activity occur
altitude where an
except during migr
observations when
seasons, it is impo
behavior of bird sp

Times When Bird

At most anytime o
strikes are more c
operations take pl
reported bird strik
numbers of strikes
hazardous since bi
USAF installations
associated with du
night during the sp

Figure 5 depicts bi
migratory months.
bird strikes is the
summer breeding s

Impact Location

The frontal surface area of an aircraft, duration of exposure, and the type of mission is directly related to the frequency of reported bird strikes for hours flown. Figure 2 shows the percentage of total bird strikes by impact location.

Again, transparencies and engines continue to lead the list. As a result of data provided by the BASH Team the transparencies to the F-15E have been improved to withstand heavier birds at high airspeeds. However, this has not eliminated the hazards to the aircrew while operating low-level. Shortly after the improved windscreen was installed on the F-15E, a crew operating over Dare County Range in North Carolina sustained a bird strike that shattered the windscreen but did not penetrate the cockpit.

Bird Strikes by Altitude

The distribution of bird strikes by altitude remains typically constant from year to year. At almost any altitude birds may be encountered. The highest strike recorded was at 37,000 feet. Most birds fly much closer to the surface. Over 95 percent of all reported strikes are reported at or below 3,000 feet above ground level (AGL). Figure 3 shows bird strikes by altitude. Strike rates drop dramatically as altitude increases. Since most bird activity occurs close to the ground, this is to be expected. Any increase in the altitude where an aircraft operates significantly reduces the potential for a bird strike except during migratory activities. The BASH Team continues to stress these observations when interfacing with pilots and mission schedulers. During migratory seasons, it is important for aircrew to be cognizant of migratory corridors and associated behavior of bird species which may be encountered.

Times When Bird Strikes Occur

At most anytime of the day or night a bird strike may occur. Typically, though, bird strikes are more common at specific times of the day. The vast majority of USAF flight operations take place during the daylight hours and this accounts for the number of reported bird strikes. Figure 4 shows reported bird strikes by time of day. Although the numbers of strikes reported during dawn and dusk are low, these times are particularly hazardous since birds are extremely active during dawn and dusk. In some instances, USAF installations have adjusted departures and recoveries to avoid bird hazards associated with dusk and dawn. Migratory activity accounts for most strikes reported at night during the spring and fall.

Figure 5 depicts bird strikes by month. As expected, the numbers increase during the migratory months. During August, September, and October the frequency of reported bird strikes is the greatest. This corresponds with their movement south following the summer breeding season.

Bird Strike by Phase of Flight

Bird strikes are reported in all phases of flight. Bird strikes on and around the airfield account for more than 60 percent of all reported strikes (Figure 6). Aircraft operating in and around the airfield are traveling at relatively slow airspeeds. The damage sustained for aerodrome reported strikes is normally minimal due to the slow aircraft speeds.

Slightly over 25 percent of the reported strikes occur during range and low-level operations, however these strikes are the most severe and costly. Two thirds of the Class A mishaps since 1987 occurred during range and low-level operations and account for all the fatalities for this period. Careful airspace planning, development, and scheduling help to reduce bird strikes during operations in this environment. The BASH Team continues to invests efforts and money to reduce the low-level strike potential. Expanding the BAM is 50 percent complete. Completion is projected for late 1993. The current model includes waterfowl and some raptor hazards for the continental United States. The expanded model will include additional raptor species, gulls, pelicans, cranes, and other hazardous flocking species. Units using the current BAM have observed reduced numbers of strikes.

Dover AFB, Delaware has successfully employed radar to identify Snow Geese movements between late fall and early spring. In addition to this current use of radar, the Next Generation Weather Radar (NEXRAD) will discriminate bird movement from weather phenomena. NEXRAD is a tri-agency program between the Departments of Commerce, Transportation, and Defense. Once fully deployed NEXRAD, a network of state-of-the-art doppler weather radars, will provide improved detection of severe and economically significant weather events over the continental United States and portions of the Pacific and Europe. Results indicate this doppler weather radar can detect bird movements as well as provide altitude information. This information may provide bird hazard information during mission planning and should enhance avoidance during flight. The BASH Team sponsored the development of a bird recognition algorithm for inclusion in this system. During the next phase the BASH Team will explore the development of a bird warning system. NEXRAD will provide "near real-time" information. The need for a real time bird warning system still exists. We continue to explore technologies to fill this void.

Birds Identified in Strikes

A wide range of bird species have been identified following collisions with USAF aircraft. Units forward post-strike remains to the BASH Team when they cannot be identified locally to the genus and species level. Most of the remains received for identification are forwarded to Ms. Roxie Laybourne for microscopic analysis. The birds identified indicate raptors, particularly Turkey Vultures, are responsible for a majority of the most damage sustained. Table 1 lists the birds most commonly identified birds in aircraft mishaps without regard to damage or cost.

Summary

The Air Force
remains the mo
number of Clas
have been repo
BASH potential
low-level route
success in conse
these goals be r
and will work to

Summary

The Air Force continues to suffer fatalities, injuries, and lost and damaged aircraft. 1987 remains the most costly year on record in terms of lives and damage. Since 1987 the number of Class A mishaps has declined and no fatalities attributable to bird strikes have been reported. Nonetheless, much remains to be accomplished to reduce the BASH potential during all phases of flight. With efforts focused on the expanded BAM, low-level route evaluation, NEXRAD, and emerging technologies we can expect more success in conserving USAF resources and aircrew lives. Only through cooperation can these goals be realized. The USAF BASH Team remains committed to this challenge and will work to explore and expand efforts to this end.

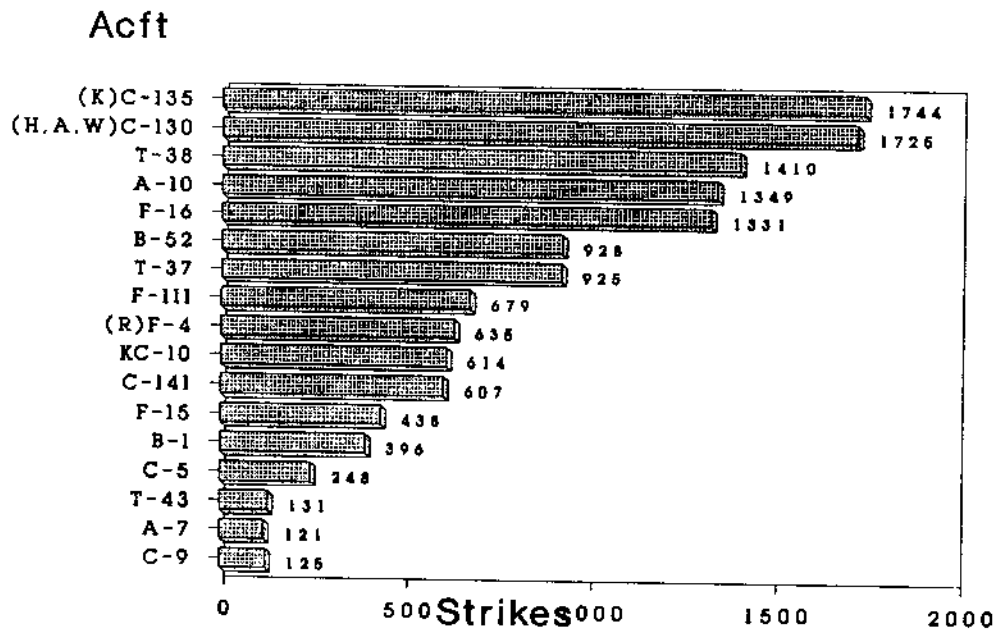

Figure 1. Strikes by Aircraft Type

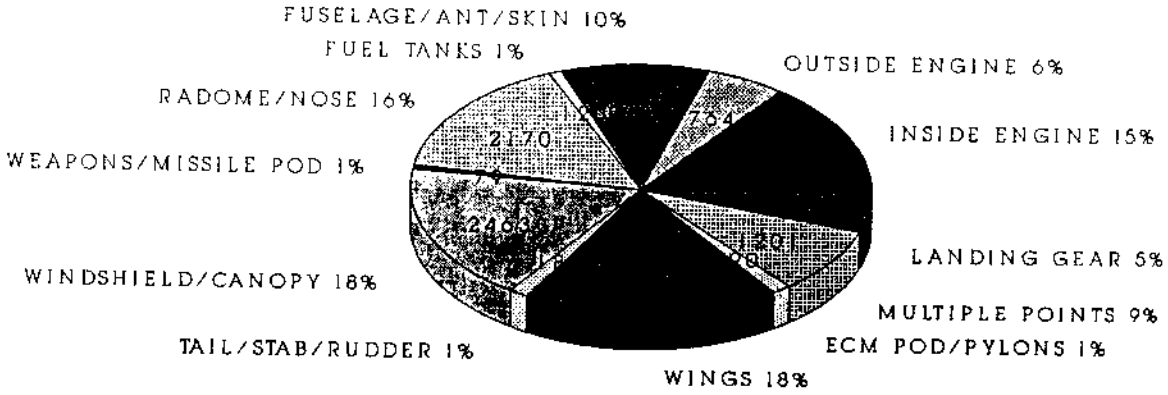

Figure 2. Strikes by Impact Point

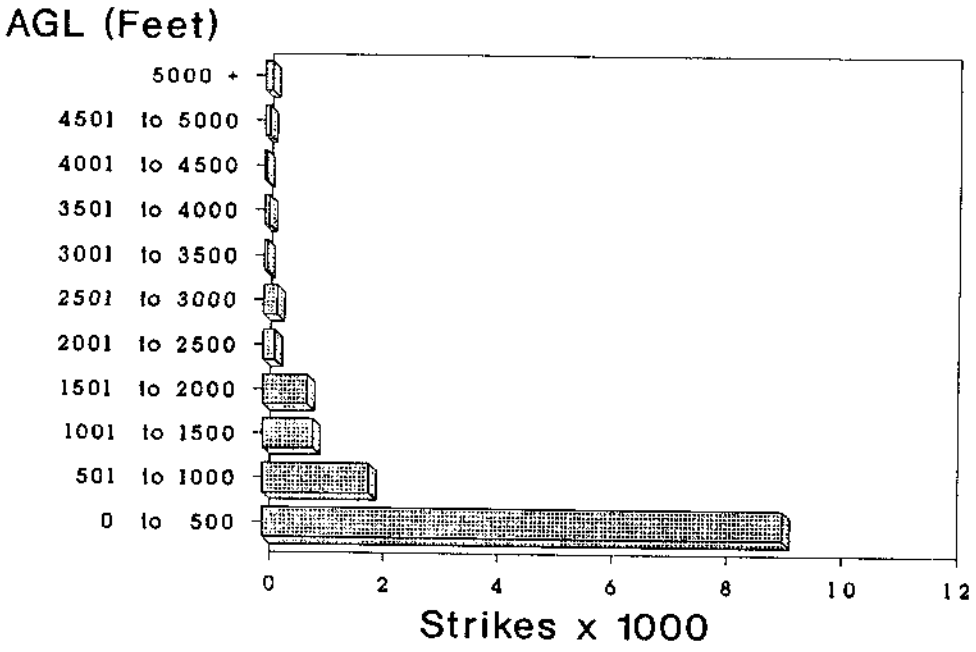

Figure 3. Strikes by Altitude

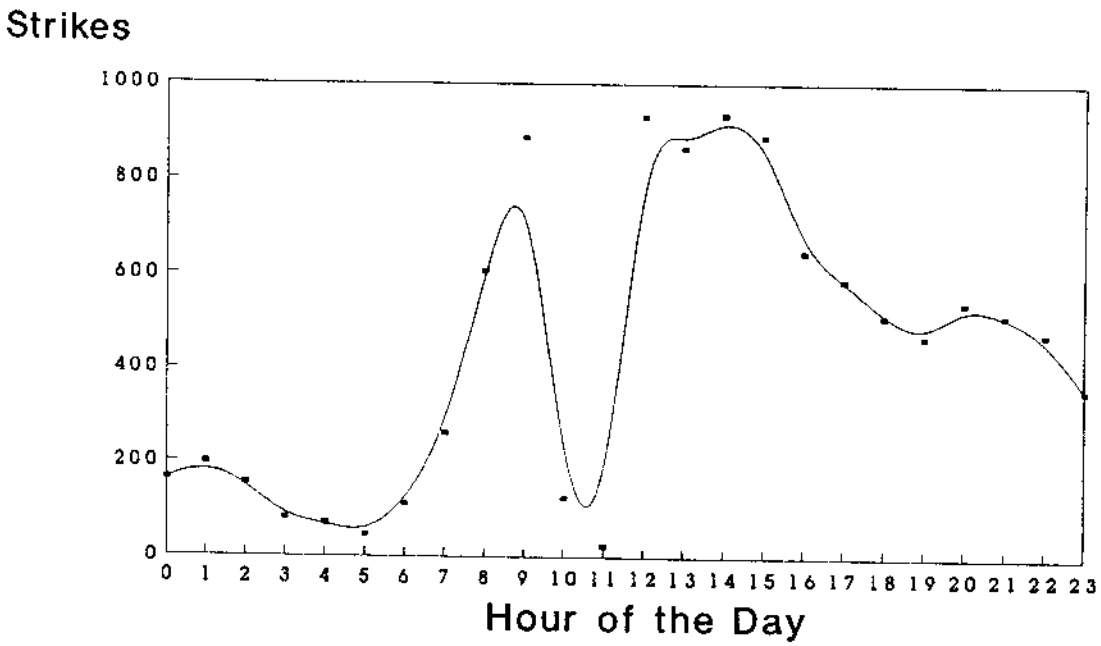

Figure 4. Strikes by Hour

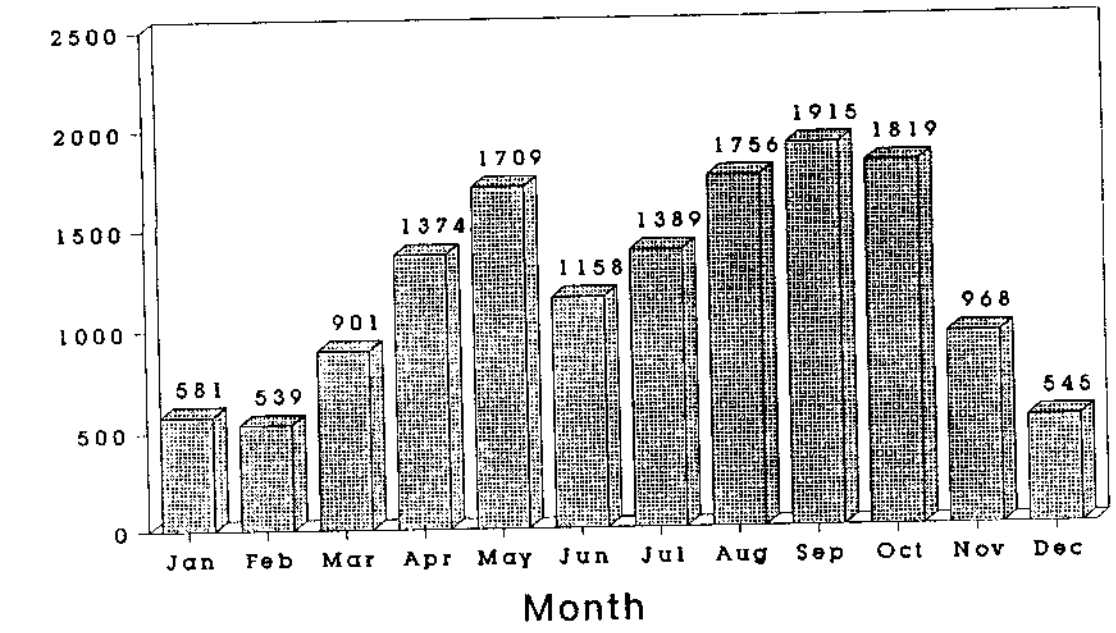

Figure 5. Strikes by Month

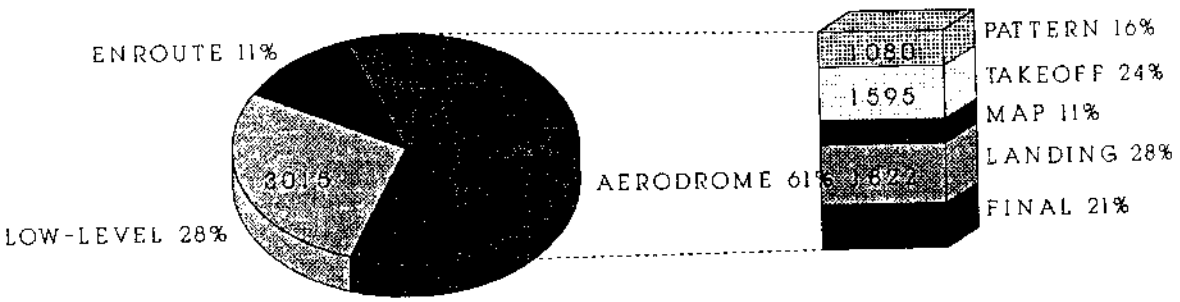

Figure 6. Strikes by Phase of Flight

SPARROW	434
HORNED LARK	124
TURKEY VULTURE	122
GULL	114
BLACKBIRD	64
MEADOWLARK	59
RED-TAILED HAWK	58
BLACK VULTURE	57
BARN SWALLOW	53
MOURNING DOVE	50

Table 1. Birds Identified in Strikes